Wages, Safety and the Establishments' Labour Supply

by

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Abstract

We analyse the notion of compensating wage differentials in the labour market within a framework of worker flows given by search based theory of an equilibrium hedonic wage distribution. In addition to wages, workers are have preferences for safety. Our empirical analysis shows that on average high wage establishments offer more safety, thus achieving lower worker turnover and larger supply of labour. Workers have strong preferences for higher wages and better safety. Depending on whether one control for fixed establishment and/or individual effects, for workers' utility level to stay unchanged when job hazards increases by 1 percentage point, the needed daily wage raise ranges from 17.25NOK to 96.79NOK.

JEL-code: C23, C33, J28, J32, J41, J63.

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1. Introduction

In this paper, we study empirically how establishments manage their labour supply by choosing the appropriate policy regarding wages and safety. How does absence and safety relate to wages?

In economics, the main strand of thought analysing the relationship between wages and safety, is based on the assumption that employees have preferences over different bundles of wage-risk-combinations, while firms taking into account costs in providing safety, offer job contracts consisting of different combinations of wages and risk. Profit maximising behaviour of the firms and utility maximising behaviour of the individuals, then result in matches between employees and firms having the same evaluation of the relationship between wages and risk. The modelling of this mechanism traces its origins back to the seminal study of Rosen (1974), who introduced the concepts of hedonic prices. The concept is central in the literature on compensating wage differentials. The framework is used in several subsequent studies, e.g., Viscusi (1978), Arnould and Nichols (1983) and Vistnes (1997).[1]

The hedonic wage frameworks is not particularly preoccupied with what happens if workers are allowed on-the-job search and frictions characterise the labour market. In the standard equilibrium search framework, the theoretical developments based on Burdett and Mortensen (1998), have established the importance of the firm's wage policy in managing its labour force.[2] However, since the previously noted study of Rosen (1974), it has been acknowledged that workers have preferences for non-wage job amenities. Homogenous firms offer contracts of equal value in utility, but may offer different bundles of wages and non-wage job amenities. The introduction of search frictions and on-the-job mobility changes this, by allowing even homogenous establishments to offer job bundles of unequal

[1] A second strand of thought focuses on the selection of employees depending on personal characteristics to different jobs. When we observe low propensity for absence among employees in certain establishments, this may be a reflection of the fact that in these establishments the compensation scheme is such that it attracts employees less inclined to experience a job accident, i.e., more able workers when it comes to coping with job hazards. See, e.g., Barmby et al. (1994) for a treatment of absence in the efficiency wage framework. In one interpretation of the efficiency wage theories, absence may be interpreted as shirking. However, note that sickness absences due to injuries, i.e., fractures, are more difficult to relate to shirking.

[2] Due to frictions, equilibrium is characterised by wage dispersion, and each single firm or establishment faces its own individual upward-sloping labour supply curve, where higher wages result in fewer quits and easier to attraction of replacement hires.

worth. What are the empirical implications? Do we still e.g., identify an upward sloping labour supply curve facing each establishment?

This paper present an empirical study of the labour supply facing each establishment, motivated by a model acknowledging frictions, search and an endogenous equilibrium hedonic wage distribution. To the author's knowledge, this has not been done previously.

Our theoretical background is found in Hwang, Mortensen and Reed (1998), who incorporate the concept of hedonic wages into theories of an equilibrium wage distribution. Workers have preferences for not only wages, but also for some non-wage components. In the Hwang et al.-model, wages and non-wage components are additive arguments in the workers' utility function. This model predicts that firms that have the same cost structure in providing the non-wage component, provide equal amount, i.e., they invest in the non-wage component so that marginal cost equalises the marginal utility workers receive from the non-wage component. Thus, with respect to utility workers receive, there is an unique ranking of the firms' contracts. However, this ranking depends on the equal cost assumption, and more cost efficient firms provide larger amounts of the non-wage component, and thus offer contracts at least as attractive as the less cost efficient firms. Offering higher wages or larger amounts of the non-wage component are two different ways to reduce worker turnover.

As previously noted, we focus on the relationship between wages and safety. We start out by presenting a slightly modified version of the model of Hwang et al. (1998). To better facilitate the following empirical analysis, we introduce a standard multiplicative utility function (e.g., a Cobb-Douglas utility function).

Then we proceed by conducting an empirical analysis of establishments' wage and safety policy. By utilising data sets for Norwegian wage earners during 1994-96, we study the simultaneous determination of wages and safety, as well as the flow of men and women through the establishments in considerable detail, thus shedding light on the empirical predictions of the theoretical model. Our analysis shows that on average high wage firms offer more safety, and they achieve a larger labour supply. Providing safety is, however, very expensive for the establishments. We identify strong convex worker preferences for safety. Thus, workers have clear preferences for higher wages and better safety.

The essay is structured as follows. Section 2 describes the data. In section 3 we discuss problems relevant for empirical analyses of wages and safety, describe the imputation of safety into our main data set, and perform an introductory within-establishment analysis of wages and safety. Section 4 presents our theoretical model. In section 5 we construct our measures of the establishments' wage and safety premiums, while we in section 6, turn to estimating the model's structural equations. Section 7 concludes the essay.

2. The Data

The empirical analyses utilise two data sets; the main data set includes information on wages, but a second data set is needed for measuring safety.

The main data set comprises all employers and employees in Norway 1994-6, i.e., more than 170000 employers and 2000000 employees each year. The data set is identical to an integrated register based data system, Current System for Social Data (CSSD), linked by Statistics Norway. It comprises of information from, e. g., the register of employees and employer, the registers of unemployment, the register of salaries and taxation and the register of education. An important feature in these data, is that the individuals as well as the establishments and firms are identified by an unique identifying codes (separate number series). In our data set, these original numbers have been replaced by encrypted numbers, but still uniquely identify each individual, each establishment and each firm.

This data set is a linked employer/employee data set that includes information on individuals, i.e., individual characteristics such as gender, level of education, wages, and on purely establishments/employer-specific characteristics such as industry and sector. Unfortunately, neither information on absence spells nor on occupations are included in the main data set. A previous version of the data set is documented in Barth and Dale-Olsen (1999).

The second data set is based on a 10 per cent representative sample of jobs from the main data set for 1995, i.e., it comprises of more than 17 000 employers and over 200 000 employees. However, the encrypted person identifying numbers are different from encrypted person identifying numbers in the main data set, thus making it is impossible to link the two data sets. The reason for this, is sensitivity issues. Also, for the same reason, the information included are less detailed. Each individual is restricted to having one job only at a given point of time, and e.g., wages are not known. However, this second data set does include information on diagnosis-specific, physician certified, sickness absences of spells longer than 3 days, which allow identification of injury-related absences. This data set is documented in Mastekaasa and Dale-Olsen (2000). From these data, we estimate the probability of experiencing absence due to injury for fulltime private sector workers employed in establishment with more than 25 employees.

Note that we do not know where and on what occasion, the worker's injury was acquired. According to official statistics (the yearbook), 31061 cases of work related injuries was reported to the official organs supervising work place related accidents in 1995, but they note that (probably) too few cases are reported. Since roughly 2000000 jobs existed during 1995, this makes an incidence rate of 1.5 per cent. We measure an incidence rate of 4.6 per cent, which clearly is higher. Obviously, this is partly caused by non work related injuries. Note, however, that the higher incidence rate in our material is also a reflection of injuries treated by physicians, but not reported to the proper authorities as work place accidents.

In our analysis, we focus on full-time workers in private sector establishments where we observe wages for at least 50 employees each year. This restricts the main data set to roughly 1500000 observations (more than 500000 workers and 4018 employers). Only private sector establishments can be considered truly profit maximising, and we know that there exists greater uncertainty regarding earnings for part-time workers. Furthermore, in Barth and Dale-Olsen (1999), we showed that the labour supply facing small establishments is unaffected by these establishments' wage policy. There are two reasons for this. Firstly, a certain number of employees are required to make a wage policy visible and credible. A large establishment will employ workers at different levels of seniority at any one point in time and may thus display its wage policy continuously, adding credibility both to future wage policy and job-opportunities. Secondly, the estimated wage policy are calculated with large uncertainty (as well as with measurement errors and integer problems) for the very small establishments.

In the system of equation estimation on the establishment level, only establishments existing for at least 5 years are included in regressions. The reason for this restriction is the need for instruments in the estimation of the equations. Several of these instruments convey information from previous periods, and are thus predetermined and exogenous in the regressions. This restricts the number of establishments to 3544.

3. Imputing a Measure of Safety and an Introductory Analysis

3.1 Empirical problems when studying the relationship between safety and wages

When examining the relationship between wages and safety empirically, several problems do arise. Some are related to the questions of how to measure the theoretical concepts, e.g., safety, while other are related to the more difficult questions of potential sources for bias. Several bias sources are identified in the literature: i) wages and safety may be regarded as endogenous variables in an individual working decision (Garen 1988), ii)skills, individual productivity and job amenities (e.g., quality of safety) are unobserved, and thus giving rise to an omitted variable bias (Brown 1980, Duncan and Holmlund 1983, Hwang, Reed and Hubbard 1992), and iii) since a simultaneous determination of safety and wages occur in the establishments profit maximisation, errors in measuring the establishments' cost structure in providing amenities generate bias (Hwang, Mortensen and Reed 1998).

In this empirical analysis we partly take into account these sources of bias. We do conduct a multi-stepped estimation to reduce endogeneity problem, both on the individual as well as on the establishment level. But even though we have extremely good measures of skills and individual productivity, we acknowledge that workers have preferences for non-wage amenities in addition to safety. Also, we do not observe the establishments' costs in providing safety.

Finally, one should be aware that we draw inference on safety from individual sickness absences due to injuries. This obviously merits a discussion, particularly with respect to the potential endogeneity problem. It is rather obvious that safety may influence an employee's health. Through the work environment and through job-specific tasks, the worker is exposed to different risks of accidents. The importance of job characteristics' possible detrimental effect on worker health has been recognised since the late 1920s.[3] The question of whether or not sickness absences caused by injuries reflect safety conditions in a firm, raises several issues.

First, do absences reflect health problems, or in other words, does a sickness absence spell of an employee reflect worse health due to illness and the need to recuperate? The

[3] This has been recognised since the pioneering works of Vernon and Bedford's studies of the relationship between working conditions and absence among British coal miners (Vernon and Bedford, 1928). However, solely specific chemical substances or physical risk factors do not constitute the only factors that affect the health of the employees. Particularly, the combination of work demand and low control of job, may have strong negative impact on employees' health (e.g., Karasek, 1979).

answer is that it may, but it does not have to. Sickness absence may be regarded as an illness behaviour (Mechanic 1986), where each individual monitors his or her health, interprets symptoms and takes whatever measures or steps she or he deems necessary. If a negative development of health occur, it does not have to result in a sickness absence spell. And even if the same negative impact on health happens to two different workers, they may not react identically. Assuming identical job characteristics, this depends on personal characteristics , e.g., psychological traits and wealth.

If we allow varying job characteristics, then it is rather obvious that the same negative impact on health may not result in identical absence behaviour. An employee may perform some tasks being ill, while other tasks are impossible to perform. Also, some workers may have a more crucial role in an establishment, making it more difficult to be absent. Thus, depending on job characteristics like position, occupation, and tasks, a given medical condition may result in different absence behaviours.

Secondly, if health problems may not result in sickness absence, is there any situations where absence may be regarded as a reflection of health problems? Several studies show a strong positive correlation between self-reported health problems and long-term absence (Chaudhury and Ng, 1992, Marmot et al., 1995), while this effect is not clear for short-term absence. But by measuring only sickness absence due to injury, e.g., fractures, certified by a physician, we should reduce the influence of non-health related aspects of absence.

Having established that safety may have impact on employee health, and that physician certified injury related absences are reflections of health problems, then it follows that data on physician certified injury related sickness absences may be used to draw conclusions about the effect of work on health, and thus on job hazards.[4][5]

[4] The idea of using data on sickness absence to draw conclusions about the effect of work on health is not new. See e.g., Bourbonnais et al.(1992), Marmot et al.(1995), Messing(1997) and Mastekaasa and Dale-Olsen(2000).

[5] Recognise that by this we do not contend that an employee's injury related sickness absence is a simple reflection of only the safety in his current firm. This is a product of several factors; e.g., past-time activities and psychological traits. But even if only some small part of these absences may be interpreted as related to hazardous work, this will be reflected in correlation between safety and injuries. Thus, these absences may be viewed as a proxy for safety. We acknowledge that several measures may express firm safety, e.g., an index obtained from a questionnaire of the employees or observed accident rates. In our empirical analysis, we use information on employee sickness absences due to injuries as our measure.

3.2 Safety, wages and the individual working decision

Since safety and wages are endogenous in the workers' working decision, this may give rise to bias. If this is the only source of bias, then following Maddala (1983, pp.120) and as it is applied in Daniel and Sofer (1998), the method of correction is to conduct a two-stage estimation., i.e., estimate the probability of being exposed by Probit-estimation, and then use the predicted hazards. We are forced to impute the individual hazard rates into the main data set, thus we conceptually follow this strategy, by in step 1, estimate the probability of experiencing an injury by Probit-regression, and then in step 2, calculate the predicted probability of experiencing an injury for use in the wage equation.

However, ideally this procedure should be conducted utilising truly exogenous covariates, only. In our secondary data set, we have a very limited set of covariates, and thus a potential conflict arises between the desire to get a imputed value of high quality and the need for exogenous instruments. Thus, step 2 might not solve the problem regarding the endogeneity of wages and safety in the establishments' profit maximisation, thus we supply our analysis by a step 3 (see section 6).

We now proceed describing step 1 and 2 in closer detail. In step 1 we construct a measure of safety using information on individual physician certified sickness absences due to injury lasting more than 3 days. The measure is constructed as follows.

Firstly, we define a dummy-variable, S=1 if an employee is absent due to injury once during the observation period in 1995, otherwise S=0. Then, using very detailed information on individual specific variables like gender, education, experience, seniority (second order and cross-terms), as well as establishment-specific variables like the ratio of women, the number of employees (squared and cross-terms), mean years of education in establishment, share of employees with different kinds of education, and dummies for industry (2-digit ISIC), the probability of experiencing a sickness absence due to damage during 1995 is estimated for 86 036 full-time workers employed in private sector establishments with more than 50 employees only. The results from this estimation is presented in the appendix, table a4, and will not be commented on further. This ends step 1.

Secondly, in step 2 using the estimated parameters, the predicted probability of *not* experiencing an injury related absence spell is imputed in the main data set, calculated from the observed covariates in the main data set. This data set covers the complete period 1994-96.

Note that the data set used in estimating the parameters in step 1 is constructed from a 10 per cent sample of all the observations for 1995. This means we impute the probability, not only for workers whose observations have been used in step 1, but for all workers during 1994-96 employed in private sector establishments with more than 50 employees. This is a potential problem. Ideally, the imputation should be conducted for the same workers, or at least in the same year only. To be able to control for unobserved worker productivity characteristics, however, we need observations across time, i.e., to impute values for several years.

But one should note that our imputation is only conducted for the neighbouring years of 1994 and 1996. For this to create a problem, one has to surmise that the hazards changes significantly between 1994 and 1995 and between 1995 and 1996. We have no information supportive of such changes, and since our imputation allows us to control for unobserved worker productivity characteristics, which are essential when analysing establishment strategies, we are of the opinion that this outweigh the minor bias caused by the imputation.

The imputation is restricted to 500568 full-time workers employed in 4018 private sector establishments with more than 50 employees only. Totally, we have 1499047 observations. Finally, we construct our measure of safety by a logarithmic transformation of the predicted probability of not experiencing an injury related absence spell. This ends step 2.

In section 4, we show how our measure are utilised in determining the establishments' wage and safety policy.

3.3 An Introductory Worker Level Analysis of Safety and Wages

To provide some insight into the relationship between wages and the imputed values of safety, we conduct an introductory within-establishment analysis. How does safety affect wages given control for gender, human capital, and establishment? We answer this by estimating two equations, one log wage equation and one log safety equation, by ordinary least squares (OLS) and two-stage least squares (2SLS). This analysis also provide evidence on the standard hedonic wage methodology (as described by Hwang et al. 1998).

According to by Hwang et al. (1998), the standard hedonic wage methodology would be to regressing wages on the job amenity using ordinary least squares. Assuming that workers utility is described by a simple linear utility function, $\xi=w+\beta a$, then the estimation of B in the equation

1) $$w = A - Ba + \eta,$$

by OLS (η is an error term), provide an estimate of the workers marginal willingness to pay' (MWP) for a. However, as Hwang et al. point out, this approach generates biased estimates of workers' MWP. Both the jointly determination of w and a by profit maximising establishments, as well as being determinants of the labour supply of utility maximising workers, generate a correlation between η and a, thus creating biased estimates of B.[6] Our introductory analysis should then take into account the simultaneous determination of wages and safety.

Motivated by a multiplicative utility function ($\xi = wa^{\beta}$)[7], our econometric model is:

2) $$\ln w = a_{10} + a_{11} \ln a + b_1' X + I_f + \nu_1,$$

where b_i'Xs denote covariates like a dummy for woman, human capital variables like years of seniority(and squared), years of experience(and squared), years of education in excess of 9 years compulsory schooling, I_f denotes establishment dummies, and the ν_i's denote error terms.

We present results for equation 2) when estimated by OLS (ignoring the simultaneity issue) and by 2SLS (when taking into account the simultaneous determination of wages and safety). To secure identification in the 2SLS-case, we have to provide exogenous variation and instruments for the endogenous variables. Having nearly 1500000 observations, a

6 Note that e.g., Garen (1988), takes into account the simultaneity issues created by workers maximizing utility. However, the establishment-dimension is not explored. His main equation has a semi-logaritmic form, i.e., $\ln w = \beta_0 + \beta_1 a$, where a denotes the probability of injury.

7 This multiplicative utility function is primarily chosen for being comparable with the analysis in section 5 and 6. See section 5 for a discussion of the relevancy of a multiplicative utility function.

limited set of characteristics and rather closely related equations, have made it difficult identifying good instruments.[8]

In the wage equation, motivated by the thought that parents influence the worker's attitude towards risks, we instrument safety by log total taxable income for the worker's mother and father, dummies for father being self-employed in the primary sector (farmer, fisherman, forester) or father being self-employed in other sectors, predicted risk probability for the worker's mother and father, and dummies for mother and father being alive and dummies indicating whether they are wage earners.[9]

Table 1 presents the results from our introductory empirical analysis. Regardless of specification (OLS or 2SLS), we see that safety are highly significant in the wage equation, respectively, but that OLS or 2SLS yield qualitatively different results. In both regressions we have controlled for establishment. The OLS-estimate implies an estimate of β equal to ÷1.96, yielding a wrong-signed MWP estimate.

When we take into account of the endogenous nature of wages and safety in the 2SLS regression, we identify the expected negative relationship. Both covariates are on log form, thus the estimated parameters can be interpreted as elasticities. From table 1 we see that increasing safety by 1 per cent, decreases wages by 2.04 per cent. Note that this estimate is from Within-establishments regressions, i.e., we have controlled for variation on the establishment-level, e.g., different establishment cost structure and different productivity. Thus, the elasticity from the wage equation provide an estimate of β=2.04, which is cleansed from establishment-effects. The large difference between our OLS-estimate and our 2SLS-estimate implies that endogeneity related to worker behaviour still plays a role.

This result should not be as surprising, since that in this introductory analysis, we have not controlled for individual fixed effects. Even if absences due to injuries are more exogenous occurrences than ordinary sickness absences, unobserved individual characteristics may affect the individual's propensity to experience an injury. This is

[8] Thus, unfortunately, in some respects, our instruments are weak and the motivation slightly ad hoc, but the reader should note that the regressions include establishment dummies as well as some individual control variables, e.g., human capital variables. The former dummies take care of all establishment variation, while the human capital variables reduce further what is left for the instruments to explain.

particularly true since we do not know where and how the injury occurred. Having observations of workers covering several years allow us to control for individual fixed effects, and thus in the next section we turn to estimating establishment-specific wage and safety policy measures cleansed from workforce fixed effects.

Table 1. The Relationship between Wages and Safety on the Worker Level.
Within- Establishment Regressions.

	Ln(wage)	
	OLS	2SLS
Ln(psafety)	1.9636***	-2.0444***
	(0.0103)	(0.2191)
+ intercept, year dummies, education(years), woman, seniority(years) and potential experience (years) and their squares, dummy for participant in fulltime education, dummy for child born year of observation, number of small children between 1 and 7 years of age, dummy for participating in part-time education, and 4017 establishment dummies.		
Instruments and excluded covariates in second step of 2SLS-regression: Dummies for mother/father not living, dummies for mother/father not being wage earners, dummy for father being self-employed as farmer/forester or fisherman, dummy for father being self employed not in primary sector, log(taxable income) of mother and father, predicted risk probability of mother and father.		
Strength of instruments[10]:		
Improvements in R^2-adj. from inclusion of the instruments in first step		0.0100
Basman-test		0.1995
Number of observations	1499047	1499047
R^2-adj.	0.3445	0.3285

Note: Column head denotes dependent variable as well as methods of estimation. Ln(wage) denotes log(daily earnings). Ln(psafety) denotes log(predicted probability of not experiencing a sickness absence due to injury). Both regressions include intercept. OLS- and 2SLS-regression. Standard errors in parentheses. Uncorrected standard errors. *** denotes a 1 per cent level of significance, respectively. Source: Own calculation on CSSD.

[9] In order to reduce measurement errors with respect to the instruments, which also have the added bonus of making the Basman tests satisfying, we have included a dummy for participating in fulltime education and a dummy for having a child born the year of observation. Note also that if one worry about the appropriateness of log total taxable income for the worker's mother and father as instruments for safety, the positive impact of these on safety, implies that any potential bias is positive, i.e., our estimate is not as negative as it should be.

[10] Note that, due to hardware limitations, we have not been able to conduct the Basman test (Basman, 1960) and other tests for the appropriateness of the full 2SLS-regression (1500000 observations and 4000 establishment dummies) using the whole sample of observations. However, we acknowledge the need for such tests. Thus, even though it is not a perfect solution, we have 100 times, at random, drawn 50 establishments and all their employees, and run the 2SLS regression on these observations (roughly 15000 observations and 49 dummies). Table 1 reports the average P-values for the Basman-tests and the average improvements in R^2-adj. from the inclusion of the instruments in the first step regression of the safety equation. Note that neither the un-instrumented safety in the OLS-regression has large explanatory power.

4. Measuring the establishments' policy regarding wages and safety

The establishments' policy regarding wages and safety, i.e., the employer-specific wage and safety premiums to be used in the empirical analysis of section 3.6, are constructed in a less elaborate way.

We start by simply decompose wages into premiums paid by the establishments (fixed establishment effects) and premiums associated with the individuals (fixed worker effects) (as it previously has been done several times). Then we proceed by doing the same for Pr(safety). These establishment-specific wage and safety premiums then express our measures of the employers wage and safety policies. These decompositions are described by the following simple econometric specifications:

3) $$\ln w_{ift} = a'_{10} + b_1' X_{ift} + \eta_{wi} + \Delta_f + \omega_{wift},$$

4) $$\ln a_{ift} = a'_{20} + b_2' X_{ift} + \eta_{ai} + \Gamma_f + \omega_{aift},$$

where subscript i, f and t denote worker, establishment and time, respectively. x_{ift} describes time-varying covariats as well as time dummies.[11] Δ_f is defined as an establishment specific wage premium of establishment f relative to the alternative wage of its workers. Similarly, Γ_f is defined as an establishment specific safety premium of establishment f relative to the alternative safety of its workers. η_w and η_a denote the workers' fixed effects with respect to wages and safety, respectively. ω_{ift} 's are error terms assumed having standard properties.

Note three important characteristics from these regressions. First of all, when viewing 3) and 4) separately (e.g. equation 3) as a log wage equation with fixed effects), η_{wi},η_{ai}, Δ_f,Γ_f are considered fixed, identified by the presence of movers. We are not able to identify these premiums in establishments where nobody moves. Second, the wage and safety policy measures Δ_f and Γ_f are not affected by the individual fixed effects (η_{wi}, η_{ai}).

[11] b_i'Xs include the basic time-varying human capital variables (years of seniority (and squares), years of potential experience (and squares) and time dummies.

However, the reader should be aware that in the hedonic wage framework, productivity is no longer measured by wages only, but also by safety. Thus, η_{wi} cannot be interpreted as the fixed productivity characteristic of a worker, as in the ordinary panel data literature on wages. Similarly, Δ_f cannot be interpreted as the fixed productivity characteristic of the establishment.[12]

In the following sections, we refer to η_{wi},η_{ai}, Δ_f, and Γ_f, as fixed worker and establishment effects, and treat the ω_{ift} 's as error terms with standard properties, but ask the reader to have in mind our reservations regarding the interpretation.

Our data is a unbalanced panel. If we now apply the standard text book approach to identify two-ways fixed effects on huge balanced panels, i.e., conducting the ordinary within-individual and within-establishment transformations followed by an OLS regression of the transformed data, our estimates will be biased. Having only 4018 establishments make the dummy approach possible. Thus, we conduct the within-individual transformation by subtracting the individual's means of all variables including 4018 establishment dummies, and run an OLS regression on the transformed variables. For instance, on the wage equation, we conduct the transformations $\ln x^*_{if} = \ln x_{if} - \overline{\ln x_{i\cdot}}$, $I^*_{if} = I_{if} - \overline{I_{i\cdot}}$ and $\ln w^*_{if} = \ln w_{if} - \overline{\ln w_{i\cdot}}$, and run the regression:

5) $$\ln w^*_{if} = \gamma + x^*_{if}\beta + I^*_f b + \varepsilon_{ift}$$

where I_f denotes a vector of 4017 establishment dummies and b denotes the associated parameter vector. Then Δ_f is estimated by $\hat{\Delta}_f = \hat{b}_f - \sum_f \frac{n_f \hat{b}_f}{\sum_f n_f}$, where n_f denotes the establishment f's number of employees. The similar method is applied to the safety equation, in the estimation of Γ_f.

[12] If we could have run the regression: $\xi=\eta_{\xi i}+\Delta_{f\xi}+\beta' X_{ift}+\omega\xi_{ift}$, then $\eta_{\xi i}$ and $\Delta_{f\xi}$ express the fixed worker and establishment effects regarding productivity.

The workers' fixed wage effects are estimated by $\hat{\eta}_i = \overline{\ln w_{\cdot i}} - b\overline{x_{i\cdot}}$, using the b-estimates from 5) and the individual means. $\hat{\eta}_i$ consists of observed fixed wage characteristics and what we define as the unobserved wage effects, α_{wi}. To identify the α_{wi}, we turn to the following model for decomposing i-te individual's fixed effects into an unobserved and an observed part:

6) $$\hat{\eta}_i = \kappa + B'x_i + \omega_i,$$

where x_i is a vector of observable fixed individual characteristics important for determining the wage, and ω_i is an error term with classical properties.

Unfortunately, theory does not indicate what is should be considered observable characteristics. We follow a basic human capital approach, and control for gender and education. Running a OLS regression of $\hat{\eta}_i$ on education, education squared, a gender dummy, intercept and a classical distributed error term, e_i, then the residual provides an estimate of α_i as $\hat{\alpha}_i = \hat{\eta}_i - \hat{\kappa} - \hat{B}'x_i$, using the OLS parameter estimates and observed education, education squared and a gender dummy. The similar method is applied for identifying the unobserved individual safety characteristic, α_{ai} .

We then continue by examining our estimated wage and safety premiums. Table 2 presents descriptive statistics for the establishments' wage and safety premiums, as well as of the establishment-specific means or the workers' unobserved fixed effects.[13] We present descriptive statistics for all establishments and for those existing at least 5 years.[14]

We start out focussing on the descriptive statistics for all establishments. The average values of Δ_f and Γ_f are ÷0.019(0.42) and ÷0.001(0.041), respectively (standard deviations in parentheses). Furthermore, Table 2 shows that Δ_f is positively correlated with Γ_f. The estimated Pearson correlation coefficient is nearly 0.20. One interpretation of this result is that high wage firms offer low risk jobs, while low wage firms offer high risk jobs. We have two reservations regarding this interpretation. First, the positive correlation between Δ_f and Γ_f is across establishments that may have different cost structure in providing safety.

[13] Strictly speaking, the wage and safety premiums are endogenous, but this is not modelled until section 6.

Secondly, this result follows from an simple observed correlation, not from a modelling of establishment choices. Particularly, note that this result does not depict the relation between the establishments' policy choices regarding wages and safety.

Next we consider the fixed unobserved worker effects. The average values of the establishment-specific means of α_w and α_a are 0.026 and 0.005, respectively.

Table 2. The Relationship between Establishment-specific Wage and Safety Premiums, and Establishment specific Means of the Worker Fixed Effects. Mean, Standard Deviations and Correlation.

	Establishments' wage and safety premiums		Mean worker fixed effects	
	Δ_f	Γ_f	$\alpha^m{}_w$	$\alpha^m{}_a$
All establishments (4018 establishments)				
Mean	-0.0189	-0.0013	0.0259	0.0055
Standard deviation	0.4204	0.0391	0.3562	0.0643
Correlation				
Δ_f	1.0000	0.2600***	0.3339***	0.1121***
	-	(0.0001)	(0.0001)	(0.0001)
Γ_f	0.2600***	1.0000	0.1686***	0.3721***
	(0.0001)	-	(0.0001)	(0.0001)
$\alpha^m{}_w$	0.3339***	0.1686***	1.0000	0.7438***
	(0.0001)	(0.0001)	-	(0.0001)
$\alpha^m{}_a$	0.1121***	0.3721***	0.7438***	1.0000
	(0.0001)	(0.0001)	(0.0001)	-
Establishments observed for at least 5 years (3544 establishments)				
Mean	-0.0127	-0.0012	0.0280	0.0046
Standard deviation	0.3790	0.0380	0.3448	0.0639
Correlation				
Δ_f	1.0000	0.1928***	0.3387***	0.1204***
	-	(0.0001)	(0.0001)	(0.0001)
Γ_f	0.1928***	1.0000	0.1833***	0.3778***
	(0.0001)	-	(0.0001)	(0.0001)
$\alpha^m{}_w$	0.3390***	0.1833***	1.0000	0.7572***
	(0.0001)	(0.0001)	-	(0.0001)
$\alpha^m{}_a$	0.1204***	0.3778***	0.7572***	1.0000
	(0.0001)	(0.0001)	(0.0001)	-

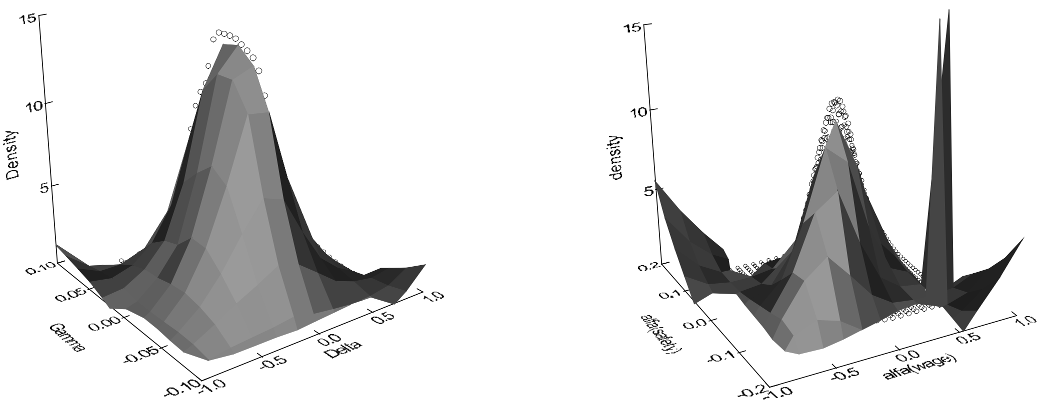
Note: Table elements comprise of mean and standard deviation of Δ_f , Γ_f, $\alpha^m{}_w$ and $\alpha^m{}_s$. Δ_f and Γ_f express the establishment-specific unconditional wage and safety premiums, respectively, while α_w and α_s express the establishment-specific mean of the unobserved individual fixed effect from the wage and safety equation, respectively. Pearson correlation between variables given by column- and row-head. P-values from tests for significance in parentheses. *** denotes a 1% level of significance. Source: Own calculation on CSSD.

[14] The reason for presenting descriptive statistics for this latter establishment population is that the need for instruments in the multivariate regressions of section 6, force us to focus on this population.

More interesting, though, is the correlation between the α's and establishment premiums, Δ_f and Γ_f. We see evidence of positive sorting both when it comes to wages and safety separately (i.e., a positive correlation between α_w and Δ_f), and when it comes to the sorting of workers having different risk propensity into establishments offering different wages. We observe for example a positive correlation between α_a and Δ_f. Our interpretation is that less risk prone workers are found in high wage establishments. Finally, we observe a positive correlation between α_a and α_w. This implies that establishments employing less risk prone workers, also employ high wage workers. Next we focus on the establishments existing for at least 5 years. Focussing on these solid establishments brings only minor changes.

Figure 1 provides graphical information on the wage and safety premiums. It shows the joint bivariate densities of (Δ_f,Γ_f) and the individual fixed effects $(\alpha_{wi},\alpha_{ai})$. The densities are estimated by normal-distributed kernels.

Figure 1 The Bivariate Densities of Wage and Safety Premiums and of the Worker Fixed Effects



Δ_f and Γ_f $\qquad$ α_w and α_a

Note: The figures show the joint densities of (Δ_f ,Γ_f) and (α^m_w,α^m_a). Δ_f and Γ_f express the establishment-specific wage and safety premiums, respectively, while α_w and α_s express the establishment-specific mean of the unobserved individual fixed effect from the wage and safety equation, respectively. The densities are calculated using normal distributed kernels.

In the figure, Delta and Gamma denote Δ_f and Γ_f, respectively, while alfa(wage) and alfa(safety) denote α_{wi} and α_{ai}. Δ_f- and Γ_f -values of 0 imply wage and safety premiums equal to the expected alternative values. We see that while the wage and safety premiums are nicely fitted around the mean values, the density of the worker fixed effect shows clear spikes for low wage workers with high fixed safety effects, and for high wage workers with low fixed safety effects.

5. A Theoretical Model of Employee Turnover and Safety

In this section we present a slightly modified version of the Hwang et al.-model of labour market frictions and job-to-job search in a hedonic equilibrium wage distribution framework, where our modification consists of incorporating a multiplicative utility function. The Hwang et al.-model may be regarded as an extension of the standard model of job-to-job search and equilibrium wage distribution (Burdett and Mortensen 1998).

Assume that a worker has preferences not only over opportunities for consumption resulting from his wage, w, but also over safety, a. Then the worker receives utility from both w and a, where we define w>0 and a>0.[15] Define ξ as the monetary equivalent of total utility of having a specific job with wage w and safety a.

Workers' deterministic utility function is assumed given by $\xi=wh(a)$, $\partial h(a)/\partial a >0$, where h(a) is any quasi concave function of a.[16] Wages and safety are set by profit maximising employers. However, let the cost c for the employer providing safety be a increasing

[15] All workers receive a positive wage, and a certain level of safety is associated with each job.

[16] In the Hwang, Mortensen and Reed (1998)-model, the utility function is additively separable in wages and the non-wage related components. In some ways, our utility function have the same characteristics as the additive utility function. Increased wages given job hazards have always a positive effect on the workers utility. Similarly, less job hazards given wages also increases utility. However, contrary to what we see in the additive utility function, the positive benefits from increased wages, are reduced by increased job hazards. We see that as the level of wages increases, more job hazards have increasingly negative impact on the utility of the workers. Thus, we argue that as the wage level increases, the more averse for job hazards the worker will become. Note that our specification is only a generalisation of the common Cobb-Douglas utility function, i.e., by assuming that $h(a)=a^{\beta}$, the Cobb-Douglas utility function arises. In the empirical part, this is the utility function that we utilise. Note that this function is, e.g., strictly quasi concave, and satisfies the requirements for an utility function. A correspondingly simple additive utility function, $\xi=w+\beta a$, is not strictly quasi concave, and thus it does not satisfy the requirements of an utility function. Note that both Hwang et al.(1998) and Van den Berg and Ridder (1998) define the equilibrium total-value-of-job-bundle distribution. Small changes to their proof determines the existence of an equilibrium hedonic wage distribution given that workers' utility is represented by a multiplicative utility function.

convex function of a, i.e., $\partial c(a)/\partial a > 0$ and $\partial^2 c(a)/\partial a^2 > 0$.[17] Assume that the efficiency of providing the safety differs between establishments. Let the type of establishment be indexed by j. Thus, for each type of establishments, we have a $c_j(a)$-function. Also, define p as the value of output per worker, and define $L(\xi)$ as the expected steady state labour supply facing each employer. We deduce the shape of $L(\xi)$ later.

The profit of an employer, and the corresponding two first order conditions of the employers maximising problem may then be written:

7) $$\Pi_j = [p - w - c_j(a)]L(\xi),$$

8) $$\frac{\partial \Pi_j}{\partial w} = -L(\xi) + [p - w - c_j(a)]h(a)\frac{\partial L(\xi)}{\partial \xi} = 0,$$

9) $$\frac{\partial \Pi_j}{\partial a} = -\frac{\partial c_j(a)}{\partial a}L(\xi) + [p - w - c_j(a)]w\frac{\partial h(a)}{\partial a}\frac{\partial L(\xi)}{\partial \xi} = 0.$$

The expected steady state labour supply, $L(\xi)$, is deduced by assuming that the number of employees an employer may hire in a given period of time, H, is an increasing function of the monetary equivalent of total utility; $H(\xi)$, $\partial H(\xi)/\partial \xi > 0$, while the fraction of an employer's stock of employees that leaves the firm over the same period, q, is a decreasing function of the monetary equivalent of total utility; $q(\xi)$, $\partial q(\xi)/\partial \xi < 0$. The characteristics of the hiring and quit functions follow from an assumption of frictions in the labour market. Also, we assume random matching (Burdett and Vishwanath, 1988).

The dynamics of the labour force of the employer are described by equation 10):

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[17] We safely admit that the relationship between safety and costs may be non-convex, e.g., by having some fixed element. However, this would greatly complicate the theoretical model, and would merit a full study. Our contribution is primarily of an empirical nature, motivated by the study of Hwang et al. (1998).

10) $$L_{t+1} - L_t = H(\xi) - q(\xi)L_t,$$

where L_t is the number of employees at time t. It is assumed that aggregating the individual separation probabilities makes quits proportional to the number of employees, and that random matching makes the number of hires a function of ξ and independent of L.

In steady state, $L_t = L_{t+1}$ and the labour supply to any one firm is given by:

11) $$L(\xi) = \frac{H(\xi)}{q(\xi)}.$$

Labour market frictions affect both the hiring and the quit function. Workers receive job offers arriving according to a Poisson process with intensity λ. Thus λ describes the job offer arrival rate. We assume equal λ for both unemployed and employed workers. A received job offer is a random draw from the cumulative offer distribution $F(\xi)$. Let $f(\xi)$ denote the corresponding wage offer density function.

Define b as non-work related income as e.g. unemployment benefits. As unemployed, a worker's utility is not affected by the non-wage characteristics. Thus, depending on the positive utility impact from the non-wage characteristics, the worker's utility from wages only, when employed in a contract (w,a) may be lower than the utility of being unemployed and receiving benefit b. With equal job offer arrival rates for unemployed and employed workers, no worker would accept a contract giving her less utility than the utility of being unemployed. Thus, the reservation value of the unemployed workers, b^*, is equal to b ($b^*=b$). Then, one may define $F(b^*)=0$.[18]

In addition, assume that workers also separate from their jobs for exogenous reasons according to a Poisson process with intensity δ. Thus δ describes an exogenous separation rate. An employee's separating rate is then given by $q(\xi) = \delta + \lambda[1 - F(\xi)]$. Unemployed

[18] If λ (the job offer arrival rate) is higher for employed than unemployed workers, then $b^* < b$.

workers who receive a job offer accept, since only contracts giving the same level of utility as being unemployed is posted. In addition, the firm hires from employed workers who receive less than ξ.

The distribution of workers over total monetary value is given by distribution function $G(\xi)$, and may deviate from the distribution of firms over total monetary values because the number of workers per firm may differ. Then the hiring function is given by:

12) $$H(\xi) = \lambda \frac{U}{M} + \lambda G(\xi) \frac{(N-U)}{M},$$

where U is the number of unemployed workers, N is the labour force and M is the number of firms in the economy. The first term expresses the number of workers hired out of unemployment, while the second term expresses the number of workers with lower (ξ), hired from other firms. By equalising the flow of new persons entering the labour market at total monetary value less than ξ , given by $\lambda UF(\xi)$, and the flow of employees leaving this tail of the monetary value distribution because of exogenous separations or quits into better paying jobs, given by $q(\xi)G(\xi)(N\text{-}U)$, and then using the expression for the steady state unemployment rate, $\delta/(\delta+\lambda)$, the relationship between the two value distributions in equilibrium is given by $G(\xi) = \delta F(\xi)/q(\xi)$.

Thus, the hiring function may be expressed:

13) $$H(\xi) = \frac{\lambda\delta}{q(\xi)} \frac{N}{M}.$$

Inserting the expression for the hiring function and the expression for the utility function, ξ=wh(a), into relation 11) gives the expected steady state labour supply to each firm by:

14) $$L(wh(a)) = \frac{\delta\lambda}{[q(wh(a))]^2}\frac{N}{M} = \frac{\delta\lambda}{[\delta + \lambda(1 - F(wh(a))]^2}\frac{N}{M},$$

where $\partial L(.)/\partial w > 0$ and $\partial L(.)/\partial a > 0$. Thus, relation 14) shows that the labour supply to each firm is increasing in wages and safety. Also, the cross derivative of labour supply with respect to w and a, is $\partial^2 L(.)/\partial w\partial a > 0$. This means that as wages grow higher, the derivative of the labour supply with respect to safety becomes higher. Or due to symmetry, as safety grow better, the derivative of the labour supply with respect to wages becomes higher. Thus, as the safety grow better, the labour supply becomes more wage sensitive.

Together with the first order conditions, 8) and 9), the elasticity of labour supply w.r.t wages and the elasticity of labour supply w.r.t safety describe the relationship between wages and safety evaluated at optimum. Substituting [wh(a)] for ξ and inserting the expressions for the derivative of labour supply with respect to wages and to safety into equation 8) and 9), then gives the following transformations of the first order conditions for type j establishments:

15) $$1 = [p - w - c_j(a)]h(a)\frac{\frac{\partial L(\xi)}{\partial \xi}}{L(\xi)},$$

16) $$\frac{\partial c(a)}{\partial a} = [p - w - c_j(a)]w\frac{\partial h(a)}{\partial a}\frac{\frac{\partial L(\xi)}{\partial \xi}}{L(\xi)}.$$

Finally, by dividing 16) on 15), the following relationship between wages and safety evaluated at optimum arises:

17) $$\frac{\partial c_j(a)}{\partial a} = \frac{w\frac{\partial h(a)}{\partial a}}{h(a)} = \frac{\xi_a(w,a)}{\xi_w(w,a)} > 0.$$

First, relation 17) says that if workers' utility is described by a multiplicative utility function (e.g., a standard Cobb-Douglas utility function), and workers have preferences for wages and safety, only, then the firms invest in safety so that the marginal cost of providing safety equates the workers' marginal rate of substitution between wages and safety. Thus, from a social welfare point of view, firms invest in optimal amount of safety.

Secondly, in contrast to the original Hwang, Mortensen and Reed-model, relation 17) implies that firms' investments in safety are affected by the wage level. Thus establishments of the same type j, no longer necessarily offer equal safety as in Hwang et al., but match investments in safety and the wage policy. Only for workers with equal marginal rate of substitution, we can identify a positive correlation between wages and safety across firms.

Thirdly, comparing safety across firms of different types j's, Hwang et al. model implies that more cost efficient firms invest more in safety. Under the assumption that the firm wants to attract workers with the same preferences for wages and safety, relation 17) implies that this is still one option, but these firms may equally well decide to offer lower wages instead.

Finally, one should note some important results from the original model of Hwang et al. (1998). Given their assumption of an additive utility function of workers, Hwang et al. show that when comparing establishments which differ in cost efficiency of providing safety, the more cost efficient establishments offer jobs that are at least as attractive as those offered by the less efficient establishments. The intuition for this is quite simply that vacancies are more expensive for more cost efficient firms. However, since the ranking of establishments with respect to both wages and working conditions depends on the cost efficiency of providing safety, not observing the cost efficiency segment reduces the relationship between wages and safety to an empirical question.

In the next section, section 6, we estimate a complete set of structural equations, for providing not only a test of the models predictions regarding establishments' labour supply, but also to study the wage-safety relationship between establishments.

6. Estimation of a Joint Wage and Safety Policy

6.1 Econometric Model

In this section, we turn to the final topic in our study, i.e., the relationship between the establishments' policies regarding wages and safety. Previously, our decomposition of wages and safety identify what we defined as firm specific wage and safety premiums. By using these measures of the establishments' wage and safety policy, we then estimate a simplified version of the structural model.

We start the derivation of the econometric model by making assumptions about the utility function.[19] Assume that the employee receives utility from wages and safety, w and a, respectively. Furthermore, let the quasiconcave function h(.) from section 3.5, be approximated by a^{β}. Thus, an employee's utility may be written: $\xi = w\, a^{\beta}$. Next, assume that the cost function of providing safety for establishments of type j may be written $c_j(a) = A_j a^{\gamma}$, where $\gamma > 1$ and A_j is a constant expressing variation between establishments in the cost structure in providing safety.[20]

Using equation 17), which describes the relationship between wages and safety evaluated at optimum, inserting the expressions for the utility function and the cost function, and making a logarithmic transformation, we find after some transformations:

$$\text{18)} \qquad \ln a = \frac{\ln \beta}{\gamma} - \frac{\ln \gamma}{\gamma} + \frac{1}{\gamma} \ln w - \frac{1}{\gamma} \ln A_j.$$

$\ln A_j$ is not observed. We approximate $\ln A_j$ by $k_1 + b_{22} X_1$, where X_1 is an vector of exogenous covariates affecting the cost structure, added an additive error term v_1.

In equilibrium, establishments earn equal profit, but they vary in establishments size. These first order conditions do not uniquely determine establishment size, but only determine wages and safety conditioned on establishment size. Thus we need an empirical expression for the expected labour supply facing each establishment, equation 14). We assume that the observed number of employees, L, is equal to the expected labour supply, L^s, multiplied an

[19] Index i for worker i is suppressed for simplicity.

[20] Note that if all establishments have different cost structure, then A_j is an establishment-specific characteristic, and j indexes establishments.

error term, e^{ν_2}, i. e., $L=L^s e^{\nu_2}$. Then using 14), and making a logarithmic transformation , yields the empirical specification:

$$19)\quad \ln L = \ln\delta + \ln\lambda + \ln(\frac{N}{M})_c - 2\ln q(wa^{\beta}) = b_{20} + b_{21}X_2 + \ln(\frac{N}{M})_c + b_{22}\ln w + b_{23}\ln a + \nu_2$$

where we have assumed that δ is a function of an exogenous vector of covariates X_2, and that (N/M) varies across counties.[21] Note that the term $b_{22}\ln w + b_{23}\ln a$ follows since the core of the q-function consists of wa^{β}.

However, the theoretical model does not explain why some establishments prefer to be small, while others prefer to be big. Thus, in the empirical model we introduce an equation determining establishment preferences for size. We assume that the observed number of employees, L, is equal to the desired labour demand, L^d, multiplied an error term, e^{ν_3}, i. e., $L=L^d e^{\nu_3}$. Making a logarithmic transformation then yields the empirical specification:

$$20)\qquad \ln L = b_{30} + \ln(\frac{N}{M})_c + b_{31}X_3 + \nu_3,$$

where X_3 is an vector of exogenous covariates thought to affecting establishments' desired size of workforce, and where ν_3 expresses and error term.

Equation 18), 19) and 20) then define our full system of equations:

$$21)\qquad \Gamma = b_{10} + b_{11}\Delta + b_{12}X_1 + \nu_1,$$

$$22)\qquad \ln\tilde{L} = b_{20} + b_{21}X_2 + b_{22}\Delta + b_{23}\Gamma + \nu_2,$$

$$23)\qquad \ln\tilde{L} = b_{30} + b_{31}X_3 + \nu_3,$$

[21] Our approach is a simplification, since Mortensen (1999) shows that the steady state distribution of workers employed in an establishment is Poisson distributed where the single parameter is equal to the inflow divided by the outflow. This makes the analysis extremely complicated.

were we measure log wages and log safety by the corresponding wage and safety premiums, Δ and Γ (which also are of a logarithmic form), and where $\ln \tilde{L} = \ln L - \ln(\frac{N}{M})_c$ due to 19).

Note that from the estimated b-parameters we are able to identify the structural parameters γ and β. It is easily seen that b_{10} and b_{11} express $\frac{\ln\beta}{\gamma} - \frac{\ln\gamma}{\gamma} + k_1$ and $\frac{1}{\gamma}$, respectively, or $\gamma = 1/b_{11}$. The derivation of β is a little bit more complicated to see. Since the core of the q-function consists of wa^{β}, the logarithmic transformation yields the expression $d\ln w + d\beta \ln a$, where d can be a constant or a more complicated function. Thus, $\beta = b_{23}/b_{22}$.

Neither p nor the cost structure of providing safety (expressed by the parameter γ), is observed, and the error terms ν's may be not only be correlated across equations, but they may also be correlated with the covariates lnL, Δ and Γ.[22] This latter characteristic cause biased estimates when conducting single equation OLS regressions, which implies that some sort of system estimation is needed, and we thus need to provide instruments for the endogenous variables.

We estimate the model (equation 21-23) by 3SLS. Note that equation 23) consists of exogenous covariates, only, and could thus be estimated consistently by OLS. Except for providing instruments and thus the identification of lnL, the estimated parameters of this equation is of less interest, and we only present results relating to equation 21) and 22). However, we present several measures of the strength of our instruments.

The full set of exogenous variables is made up as follows: 457 dummies for industry (NACE5, reference Production and preserving of meat), and the establishment-specific covariates ratio of employees participating in part-time education, ratio of employees becoming parents, ratio of non-Norwegian employees, ratio of full-time employees, log(age of establishment), growth in sales during 92-93, (growth in sales during 92-93)^2, growth in enterprise sales during 92-93, net job growth (all employees) during 91-92, net job growth (all employees) during 92-93, $\log(N/M)_c$, dummies for limited liability company or responsible company (reference joint stock company), dummy for part of multi-establishment enterprise. All dummies are measured as deviations from the mean.

[22] That the cost structure of providing the non-wage component is usually not observed, is pointed out by Hwang et al. (1998), as one cause of bias in the literature on compensating wage differentials.

In the final models, the following exogenous variables appear in the respective equations:

Equation 21): Dummies for industry, dummies for limited liability company or responsible company (reference joint stock company), dummy for part of multi-establishment enterprise, log(age of establishment).

Equation 22): Dummies for industry, ratio of full-time employees, ratio of employees participating in part-time education, ratio of employees becoming parents, ratio of non-Norwegian employees.

Equation 23): The full set of exogenous variables. Equation 23) consists of exogenous variables, only, and thus there is no need for instruments. First step regressions consist anyway of all exogenous covariates. For the 3SLS-regressions, however, omittance of variable exogenous but not directly related to labour demand in the second step, affects the estimated covariance between equations. The Basman-test indicates the inclusion of all exogenous variables.

It is of course a problem finding good instruments, especially since our data set contains limited information. In equation 21), we instrument Δ by the ratio of full-time employees, ratio of employees participating in part-time education, ratio of employees becoming parents, ratio of non-Norwegian employees, growth in sales during 92-93, (growth in sales during 92-93)^2, growth in enterprise sales during 92-93, net job growth (all employees) during 91-92, net job growth (all employees) during 92-93, $\log(N/M)_c$. In equation 22) we instrument $\ln\tilde{L}$ and Γ by dummies for limited liability company or responsible company (reference joint stock company), dummy for part of multi-establishment enterprise, log(age of establishment), growth in sales during 92-93, (growth in sales during 92-93)^2, growth in enterprise sales during 92-93, net job growth (all employees) during 91-92, net job growth (all employees) during 92-93, $\log(N/M)_c$. Note that in 2nd and 3rd step, $\ln\tilde{L}$ is predicted using all the exogenous covariates.

In order to assess the strength of our instruments, we report the results from a standard Basman-test (Basman 1960), the R^2 from the first stage regressions, the increment in R^2 in the first-stage regressions from the instruments, as well as R^2 from regressions of the endogenous variables on the instruments. Unfortunately, some of our instruments are not strong, and this may be a problem (Bounds, Jaeger and Baker 1995). This is particularly true for our instruments for Δ in equation 21).

3.6.2 Results

The system of equations is estimated using 3SLS. Our results are presented in Table 4. We focus primarily on the structural parameter estimates. In the safety (Γ)-equation, we see that Δ affects Γ positively and that the b_{11}-estimate is significant. Inverting the b_{11}-estimate of 0.0423 yields an estimate of γ equal 23.64. γ is interpreted as the elasticity of the cost in providing safety with respect to safety. Thus, providing safety clearly is expensive for these establishments. Since the model includes control for industry at an extremely detailed level, it is no surprise that other explanatory covariates turn out insignificant.

Next, we turn to the wage(Δ)-equation, which provide an the estimate of β in the workers utility function. Both b_{22} and b_{23} are significant positively, even though b_{23} is only significant at a 10 per cent level of significance. These estimates imply an β-estimate equal to 10.57. Since β expresses the elasticity of utility with respect to safety, this result implies that workers have strong preferences for safety. After taking account of the endogeneity relating to the determination of wages and safety, we find convex worker preferences for safety (or more accurate, preferences for higher probability of not experiencing injury).

Note that this estimate of β is clearly higher than what we identified in the within-establishment regressions of section 3. In section 3 we were able to control for fixed establishment-effects (and thus cost structure differences), but could not control for fixed individual effects. In this section, we have not only controlled for fixed individual effects, but also taken account of endogeneity issues, even though we have to retort to the use of instruments to achieve identification of the model. Our estimates show that the individuals personal characteristics are very important for the evaluation of safety.

As a final comment regarding our estimates, one should note that b_{22} and b_{23} may also be interpreted as the elasticitities of wages and safety on establishment size.

Table 4 Wage and Safety Policy, and Establishment Size. Private sector.

	3SLS	
	Equation 21): Γ	Equation 22): Δ
Intercept	0.0024 (0.0024)	2.5024 (2.3093)
Δ	0.0423 **(0.0176)	12.4248** (0.0413)
Γ		131.2333* (76.9296)
Part of multi-establishment enterprise	-0.0026 (0.0117)	
Responsible company	-0.0018 (0.0051)	
Limited liability (stock) company	0.0008(0.0021)	
Log(age of establishment)	-0.0012 (0.0008)	
Ratio of employees part. in part-time education		-6.9332 (2.3871)
Ratio of employees becoming parents during the period		-1.4516 (3.6913)
Ratio of employees parents with children 1-7 year old		-1.1131 (1.2043)
Ratio of full-time workers		-4.1590**(2.9868)
Ratio of non-Norwegian workers		-1.5389 (5.5326)
Number of industry dummies (5-digit NACE).	457	457
Cross model correlation:		
Equation 21)	1.00	-0.1736
Equation 22)	-0.1736	1.00
Strength of instruments		
$\ln\tilde{L}$:		
First step regression R^2		0.4458
Increment in first step regress. R^2 from instruments		0
Basman-test (P-value)		-
Δ :		
First step regression R^2	0.1879	
Increment in first step regress. R^2 from instruments	0.0020	
Regression of instruments only R^2	0.0055	
Basman test (P-value)	0.5662	
Γ :		
First step regression R^2		0.5058
Increment in first step regress. R^2 from instruments		0.0024
Regression of instruments only R^2		0.0874
Basman test (P-value)		0.8993
System weighted R^2	0.4784	
# of observations	3544	

Note: Dependent variable and method of estimation are given by column head. Δ and Γ express the establishment-specific wage and safety premiums, respectively. System of equations are estimated by 3SLS. Note that the system also include an equation for $\ln\tilde{L}$, which consists of all exogenous variables in 1st, 2nd, and 3rd step. All original dummies (e.g., the industry dummies and the ownership dummies) are transformed to deviations from the mean. Reference for industry dummies is Production and preserving of meat, while joint stock company is reference for ownership structure dummies. Uncorrected standard errors. ***, **, and * denote a 1%, 5% and 10% level of significance, respectively. Source: Own calculation on CSSD.

They imply that 1 per cent higher wage increase establishment size by 0.12 per cent, while 1 per cent more safety increase establishment size by 1.31 per cent.[23]

Our conclusion from Table 4 is that safety is highly valued by workers, even though both wages and safety matter for workers. Similarly, for the establishments, safety is expensive, but they use both wages and safety as instruments in achieving the desired labour supply. However, one should note that relative to the dispersion in wages, safety is very compressed.

In the final part of this section, we study workers' marginal rate of substitution between wages and safety somewhat closer. Given our estimates of β (from section 3 and Table 4), and under the assumption that establishments' desire to keep the labour supply constant (i.e., keeping the distribution of utility constant), we can derive workers' marginal rate of substitution between wages and safety. Differentiating the utility function, and solving for dw/da under the assumption of constant utility, yields: $dw/da = \div\beta w/a$. Thus, the marginal rate of substitution given our specification of the utility-function is $\beta w/a$.

For each establishment, given the average establishment-specific values, we then calculate the marginal rate of substitution (MRS) for 4 different cases: 1)mrs1 - using β from 3, 2)mrs2 – using β from this section, 3)mrs3 - using β from this section, but wages and safety deducted the establishment-specific fixed effects, 4)mrs4 - using β from this section, but wages and safety deducted both individual and establishment-specific fixed effects.

Table 5 presents the different values of the MRS. It is rather obvious that we calculate higher values for the MRS when using higher values for β. The figures of mrs2 implies that on average, by increasing the job hazard by 1 percentage point, the daily wage will have to be increased by 99.30 NOK for workers' utility level to stay unchanged.[24] However, from Table 5 we also see that normalising wages and safety w.r.t. fixed effects clearly result in higher figures for the MRS, even though this also means an increased standard deviation.

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[23] Note that the former result implies an establishment wage-size effect of 8.3 per cent, i.e., clearly stronger effects than reported by Brown and Medoff (1989) for US and Albæk et al. (1998) for the Nordic countries. However, they do not simultaneously control for safety. The establishment wage-size effect is studied more closely in Barth and Dale-Olsen (2001), where group-size is identified as a major source for the differential.

[24] Garen (1988) evaluates a statistical injury to \$14300 on 1981-82 data, which at exchange rate of 1\$=10NOK, equals 143000NOK. When comparing with our figures, Garen's figure ignores 15 years of inflation. Figures for mrs1, evaluated for the mean worker on 1994-96 data, implies an average evaluation of a statistical injury during a year (260 working days) to 392617NOK. mrs2, however, implies an average evaluation of 2034780 NOK.

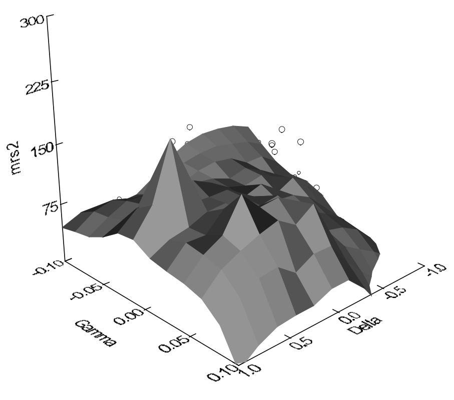
Table 5 Marginal Rate of Substitution Between Wages(NOK) and Safety (percentage point)

	Mean	Standard Deviation
1) mrs1	17.2541	5.8134
2) mrs2	89.3999	30.2145
3) mrs3	95.0637	99.3307
4) mrs4	96.7926	131.0328

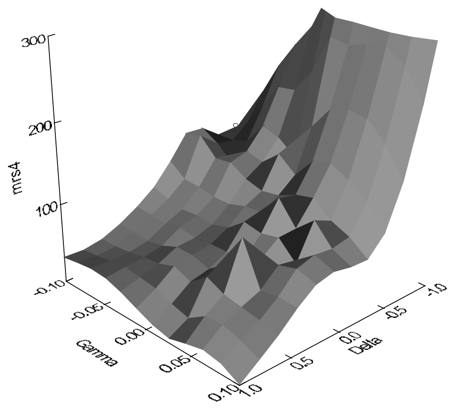
Note: The marginal rate of substitution between wages and safety is calculated for 4 different cases: 1)mrs1 - using β from section 3.3, 2)mrs2 – using β from this section, 3)mrs3 - using β from this section, but wages and safety deducted the establishment-specific fixed effects, 4)mrs4 - using β from this section, but wages and safety deducted both individual and establishment-specific fixed effects. Average establishment-specific mean of the daily wage is 744 NOK, while the average establishment-specific mean of the job hazard is 87.5 per cent. Source: Own calculation on CSSD.

In Figure 2, we show how the values for the different MRS varies across establishments offering different contracts (Δ_f and Γ_f). We only consider contracts within +/÷ 2 standard deviations of Δ_f and Γ_f, and focus on mr2 and mrs4, only. The picture on the left-hand side displays mrs2, while mrs4 is displayed on the right-hand side picture. The difference is striking.

Figure 2 The Marginal Rate of Substitution Between Wages and Safety for Different Wage and Safety Levels. Compensation in daily wage (NOK) from 1 percentage point increase in yearly job hazard



+/÷ 2 std. of Δ_f and Γ_f



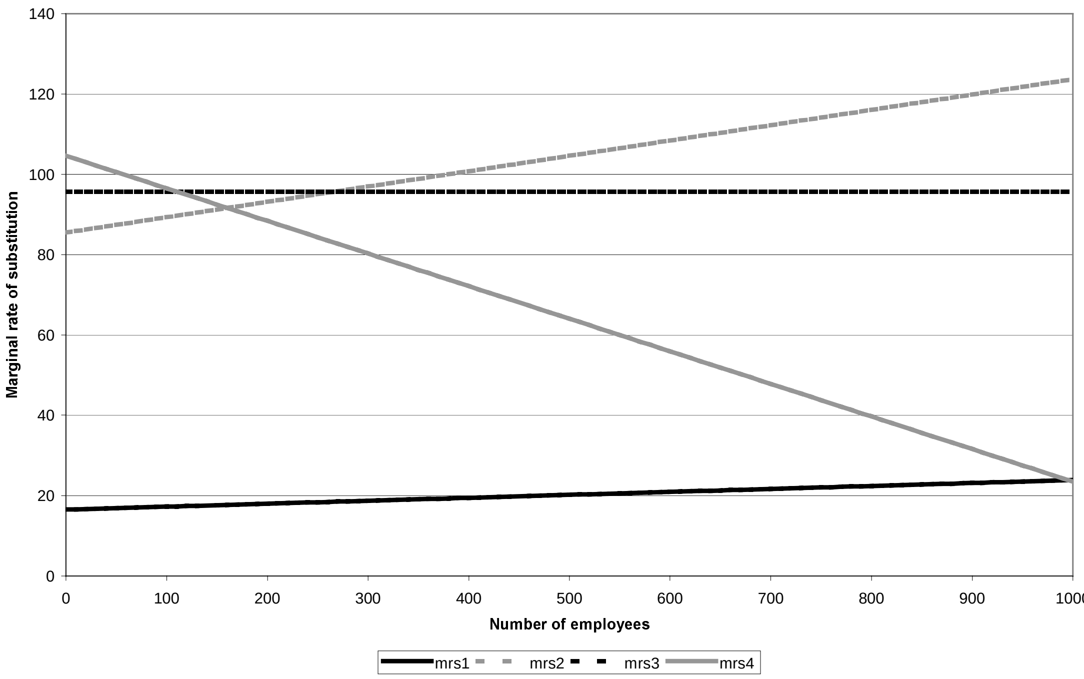
+/÷ 2 std. of Δ_f and Γ_f

Note: The figures show establishment-average of workers' marginal rate of substitution between wages and safety, mrs2 and mrs4, and establishment specific averages for wages and Pr(no injury), for the different estimated wage and safety premiums, Δ_f and Γ_f.. See footnote of Table 5 for further information on mr2 and mrs4.

Normalising wages and safety by correcting for the fixed establishment and individual effects, produces a strongly negative relationship between the MRS and the level of the wage and safety premiums. To understand why this occur, remember the reasons why establishments pay wage and safety premiums, i.e., they want to achieve a certain supply of labour. Therefore, an examining of the relationship between the MRS and the size of the establishments' workforce, may provide an answer.

Figure 3 is constructed from the estimated parameters of OLS regression of the marginal rate of substitution (MRS)(for mrs1-mrs4) on the number of employees and the number of employees squared. Average establishment size is 120 employees. The price of job hazards, thus appears more expensive in establishments facing a larger labour supply, than in establishments facing a smaller labour supply (as seen from mrs1 and mrs2).

Figure 3 The Marginal Rate of Substitution Between Wages and Safety for Different Labour Supply Levels. Compensation in daily wage (NOK) from 1 percentage point increase in yearly job hazard.



Note: The figure displays the relationship between the marginal rate of substitution(MRS) and the establishments' number of employees, given by OLS regressions of the MRS on the number of employees (and squared). The regression results are presented in table a5 in appendix 2. MRS is calculated for the 4 different cases described in the footnote of Table 5.

However, larger establishments pay wage and safety premiums to attract the larger number of employees (and keep those already employed).

Normalising the establishments' wage and safety premiums show that the size effect disappears (as seen by mrs3). By paying positive wage and safety premiums establishments attract workers with higher individual fixed effects. If the fixed individual effects do not vary across establishments, normalising both fixed establishment-and individual effects should not affect the MRS. However, as seen in Figure 3 it reduces the MRS (as seen by mrs4). Thus, by paying their wage and safety premiums, larger establishments not only are able to employ more workers, they also employ workers with higher MRS between wages and safety. Thus, larger establishments are more cost efficient in providing safety.

7. Conclusions and Caveats

This paper has presented an empirical analysis based on a model of the labour market incorporating labour market frictions and hedonic wages. In the introductory analysis of section 3, taking account of endogeneity between wages and safety, we identify a negative correlation between wages and safety, which implies strong worker preferences for safety. The log wage equation provides an estimate of the elasticity of utility w.r.t. safety of 2.04, which is cleansed from all establishment heterogeneity. When we take account of the endogenous nature of wages and safety in the establishments' contract setting, as well as control for fixed individual and establishment effects in section 6, our results are enforced. An estimate of the elasticity of utility w.r.t. safety of 10.6, implies very strong worker preferences for safety. Thus, we safely conclude worker preferences for safety are convex (or more accurate, preferences for higher probability of not experiencing injury).

Depending on whether one control for fixed establishment and/or individual effects, for workers' utility level to stay unchanged when job hazards increases by 1 percentage point, the needed daily wage raise ranges from 17.25NOK to 96.79NOK. The labour supply facing an establishment is highly sensitive to wages and safety, is confirmed in section 6, and strong positive establishment-size effects are identified. Our final conclusion is that given our reservations below, our analysis largely support the theoretical model.

Unfortunately, there are several caveats that future research should focus on. First, two kinds of information are missing, which might have improved our analysis. The analysis is weakened by not having information on the establishments' costs. In particular, information on the costs of providing safety would have been desirable. Also, it is a problem that we do not know where and how the injury occurred. Employees may very well experience accidents not related to work. However, our effects are establishment averages, we have controlled for individual fixed effects, and we do not view it as likely that high risk seeking workers, experiencing a lot of accidents in their past time, are grouped together in certain establishments.

Next, one might also worry about the use of imputed job hazard values, instead of observed values. One should, however, note that rather comparable results are found when using observed physician certified long term sickness absences instead of imputed job hazard rates (results not shown). We deemed the selection issues related to ordinary sickness absences too serious, so we choose to use the imputed values of absences related to injuries instead.

Secondly, due to the endogenous nature of wages and safety, we have been forced to use instruments in the empirical analysis. Unfortunately, we have only had access to a limited set of instruments, and thus the potential for improvement of the analysis by using better instruments is clear.

Thirdly, in our analysis we examined contracts consisting of two elements only, i.e., wages and safety. In real life, workers have preferences for several elements, and employers offer contracts consisting of several non-wage amenities. In Dale-Olsen (2002), , we show that workers have strong preferences for fringe benefits. Thus, a more comprehensive study, taking into account several contract elements simultaneously, is a topic for future research.

Fourthly, our analysis is restricted to 4 000 large private sector establishments only, and this may create some selection issues, even though we attempt to control for individual and establishment effects. And even if these establishments are few in numbers, they still employ nearly a quarter of the Norwegian labour force, irrespective of institutional sectors. Also, it is reasonable to assume that an establishment has to be of a certain size for it to have a well organised wage and safety policy, and minimum work force requirements are not that uncommon in empirical analyses.

Taking these caveats into account, we are of the opinion that in spite of the weaknesses, our study provide valuable insight into establishments wage setting behaviour.

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Appendix 1

The total utility offer distribution and its density

In Hwang, Mortensen and Reed (1998), the total utility offer distribution, F(ξ), is expressed by the following relation:

24) $$F(\xi;p,b,\delta,\lambda)=(\frac{\delta+\lambda}{\lambda})(1-(\frac{p-\xi}{p-b})^{\frac{1}{2}}).$$

The total utility offer density, f(ξ), is then expressed by the following relation:

25) $$f(\xi) = \frac{\delta + \lambda}{2\lambda\sqrt{p - b^*}} * \frac{1}{\sqrt{p - \xi}}.$$

The predicted probability of being absent due to injury

The predicted probability of being absent due to injury is calculated by estimating the probability of being absent due to injury based on a logistic probability model controlling for gender, years of education, 9 dummies for kind of education, seniority, experience, the corresponding second order term of the human capital variable, cross terms with gender and the human capital variables interacted, log(days at risk/total number of days), number of children less 7 years of age, married, ratio of women in establishment, number of employees in present establishment (and squared), cross-terms between the ratio of women and the number of employees (and squared), ratio of workers with the different kinds of education, dummies for 2-digit industry codes(ISIC), and dummies for counties. The results are presented in table a3 in the appendix.

The following ICPC(international classification of primary care)-codes are used to define *injury*: A80, A81, A82, B77, D80, F78, H77, H78, H79, H85, L72, L73, L74,L75, L76, L77, L78, L79, L80, L81, N78, N80, N81, R88, S14, S15, S16, S17, S18, S19, U89, X82, Y80. Among the codes you find, e.g., unspecified accident/injury (A80), multiple injuries and other injuries(A81), fractures (L73-79), dislocation (L80), concussion of the brain (N79), burns (S14).

Appendix 2

Table a.1 Descriptive statistics. Full –time workers in private sector establishments where we at least observe wages of 50 employees each year during 1994-96.

Variable	Mean	Stand. deviation
Employee regressions:		
Year 1994	0.3292	0.4699
Year 1996	0.3368	0.4726
Female	0.2923	0.4548
Seniority	5.2802	6.0533
Experience	27.0588	12.4343
Education	2.7368	2.5139
Seniority^2	64.5230	129.9696
Experience^2	886.7880	746.3861
Log(wages)	6.4653	0.6572
Log(Imputed safety probability)	-0.1335	0.0748
Child born the year of observation	0.0482	0.2179
Participating in fulltime education	0.0671	0.2501
Number of children between 1 and 7 years of age	0.2801	0.5839
Participating in part-time education	0.0122	0.1096
Mother not living	0.6314	0.4824
Father not living	0.6422	0.4794
Father self-employed in primary sector	0.0189	0.1363
Father self-employed in other sectors than primary sector	0.0279	0.1646
Mother not wage earner	0.8503	0.3568

….table a1…continued…		
Father no wage earner	0.7631	0.4251
Father's predicted job hazard rate	0.0152	0.0407
Mother's predicted job hazard rate	0.0284	0.0605
Father's taxable income	4.2390	5.7414
Mother's taxable income	4.2047	5.5575
# of years/# of workers/# of establishments/# of observations	3/497214/4018/1499047	
Establishment regressions:		
Log L- $\mathrm{Log}(N/M)_c$	-1.9541	0.8605
$\mathrm{Log}(N/M)_c$	6.3156	0.2810
Log(number of employees)	4.3747	0.8127
Number of employees	119.8507	175.8480
$(\text{Number of employees})^2$	45278	271799
Change in sales period 92-93	14195767	188959074
$(\text{Change in sales period 92-93})^2$	35903181061	$1.6e^{12}$
Responsible company	0.0014	0.1090
Limited liability (stock) company	0.0234	0.4125
Change in sales for the enterprise period 92-93	11309817	178008598
Log (age of establishment)	2.7073	0.6733
Part of multi-establishment firm	0.0002	0.0294
Δ_f	-0.0154	0.3733
Γ_f	-0.0007	0.0379
Ratio of employees part. in part-time education	0.0122	0.0273
Ratio of non-Norwegian workers	0.0143	0.0216
Ratio of employees becoming parents during the period	0.0496	0.0322
Ratio of employees parents with children 1-7 years of age	0.2804	0.1106
Ratio of fulltime employees	0.8759	0.1446
Establishment's net job growth period 91-92	0.0924	0.3861
Establishment's net job growth period 92-93	-0.0884	0.3861
# of industries/# of establishments/# of observations	458/3544/3544	

Table a.2. Construction of wage and safety premiums. OLS-regressions Full –time workers in private sector establ. where we at least observe wages of 50 employees each year during 1994-96.

	Wages^k	Safety^k
Year 1994^k	-0.0543^{**}	0.0021^{**}
	(0.0019)	(0.0001)
Year 1996^k	0.0714^{**}	-0.0000^{**}
	(0.0020)	(0.0000)
Experience^k	0.0097^{**}	0.0021^{**}
	(0.0020)	(0.0001)
Experience^{2k}	-0.0009^{**}	-0.0000^{**}
	(0.0000)	(0.0000)
Seniority^k	0.0023^{**}	0.0015^{**}
	(0.0004)	(0.0000)
Seniority^{2k}	-0.0002^{**}	-0.0000^{**}
	(0.0000)	(0.0000)
Number of establishment dummies	4017	4017
R^2-adj.	0.0745	0.8289
# of observations	1499047	1499047

Note: Dependent variables are $\log(\text{wage})^k$, denoted Wages^k, or $\log(1\div\text{predicted job hazard probability})^k$, denoted Safety^k. Superscript k denotes that the variables are subtracted their worker means. Standard errors in parentheses. Uncorrected standard errors. ** denotes a 1% level of significance. Source: Own calculation on CSSD.

Table a.3 Construction of individual unobserved fixed effects. OLS-regressions. Full –time workers in private sector establishments where we at least observe wages of 50 employees each year during 1994-96.

	Fixed worker effect: Wages	Fixed worker effect: Safety
Intercept	0.1991**	-0.0124**
	(0.0019)	(0.0003)
Woman	-0.3615**	0.0350**
	(0.0023)	(0.0004)
Education	-0.1828**	-0.0276**
	(0.0010)	(0.0002)
Education^2	0.0253**	0.0039**
	(0.0001)	(0.0000)
R^2-adj.	0.0979	0.0647
# of observations	630982	630982

Note: Dependent variables are the individual fixed effects calculated from parameters of table a.2. Education is measured in years in excess of 9 years of compulsory schooling. Uncorrected standard errors. ** denotes a 1% level of significance. Source: Own calculation on CSSD.

Table a.4 Probability of experiencing injury-related absences. Probit. Full-time workers in private sector establishments with more than 25 employees. 1995.

Variables	Estimate	Standard error
Intercept	-0.8717**	0.1291
Woman	-0.6487**	0.0857
Education	-0.0912**	0.0135
Education^2	0.0008	0.0015
WomanXeducation	0.0317	0.0214
WomanXeducation^2	0.0023	0.0025
Experience	-0.0208**	0.0037
Experience^2	0.0002**	0.0001
WomanXexperience	0.0191**	0.0064
WomanXexperience^2	-0.0001	0.0001
Seniority	-0.0166**	0.0035
Seniority^2	0.0001	0.0001
WomanXseniority	0.0142	0.0070
WomanXseniority^2	0.00003	0.0003
Log(days employed in 1995)	0.2910**	0.0442
Dummies for type of education:		
Humanities and aesthetics	0.0452	0.0581
Teaching	0.0999	0.0549
Adm.,econ.,social science, law	0.0156	0.0297
Industry,craft,natural science, tech.	0.0877**	0.0261
Transport	0.0879	0.0488
Health service	0.1193**	0.0458
Agriculture, forestry, fisheries	0.1989**	0.0643
Provision of services and defence	0.0746	0.0399
Establishment characteristics:		
Humanities and aesthetics^m	0.8889**	0.2113
Teaching^m	0.2691	0.1393
Adm.,econ.,social science, law^m	0.0138	0.1255
Ind.,craft,natural science,tech.^{m}	0.2006	0.0958
Transport^m	-0.1961	0.1574
Health service^m	0.2820	0.1360
Agriculture, forestry, fisheries^m	0.3678	0.2177

…table a.4 continued….		
Provision of services and defence^m	0.1888	0.1383
Education^m	-0.0985**	0.3608
Woman^m	-0.1918**	0.0132
Number of employees	-4.66e-6	4.76e-5
Number of employees^2	-7.96e-9	8.12e-9
WomanXnumber of employees	8.79e-5	8.01e-5
WomanXnumber of employees^2	-2.85e-9	1.40e-8
Number of industry dummies: 2-digit ISIC	33	
Log likelihood	-14881.2008	
Number of observations	86036	

Note: Probit estimation. Dependent variable is a dummy indicating whether the employee has experienced injury related absence. Education is measured in (years of education÷3) in excess of 9 years of compulsory schooling. Experience denotes Mincer experience, and is measured in years. Seniority is measured in years. m denotes establishment-specific means. ** denotes a 1% level of significance.

Table a.5 The Workers' Marginal Rate of Substitution Between Wages and Safety and the Establishments' Labour Supply

	mrs1	mrs2	mrs3	mrs4
Intercept	16.4930***	85.4566***	95.5840***	104.6142***
	(0.1382)	(0.7161)	(2.3766)	(3.1302)
Number of employees	0.0074***	0.0382***	-0.0081	-0.0812***
	(0.0010)	(0.0053)	(0.0176)	(0.0232)
Number of employees^2	-0.000002***	-0.000013***	0.000009	0.00004***
	(0.000001)	(0.000003)	(0.0001)	(0.00001)
R^2-adj.	0.0185	0.0185	-0.0002	0.0029
# of observations	3544	3544	3544	3544

Note: Observations are establishment-specific means across the period 1994-96. Column head denotes dependent variable. mrs1-mr4 denote four different calculations of the marginal rate of substitution between wages and safety is calculated for 4 different cases: 1)mrs1 - using β from section 3, 2)mrs2 – using β from this section, 3)mrs3 - using β from this section, but wages and safety deducted the establishment-specific fixed effects, 4)mrs4 - using β from this section, but wages and safety deducted both individual and establishment-specific fixed effects. Standard errors in parentheses. Uncorrected standard errors. Standard errors in parentheses. *** and ** denote a 1% and 5% level of significance, respectively. Source: Own calculation on CSSD.